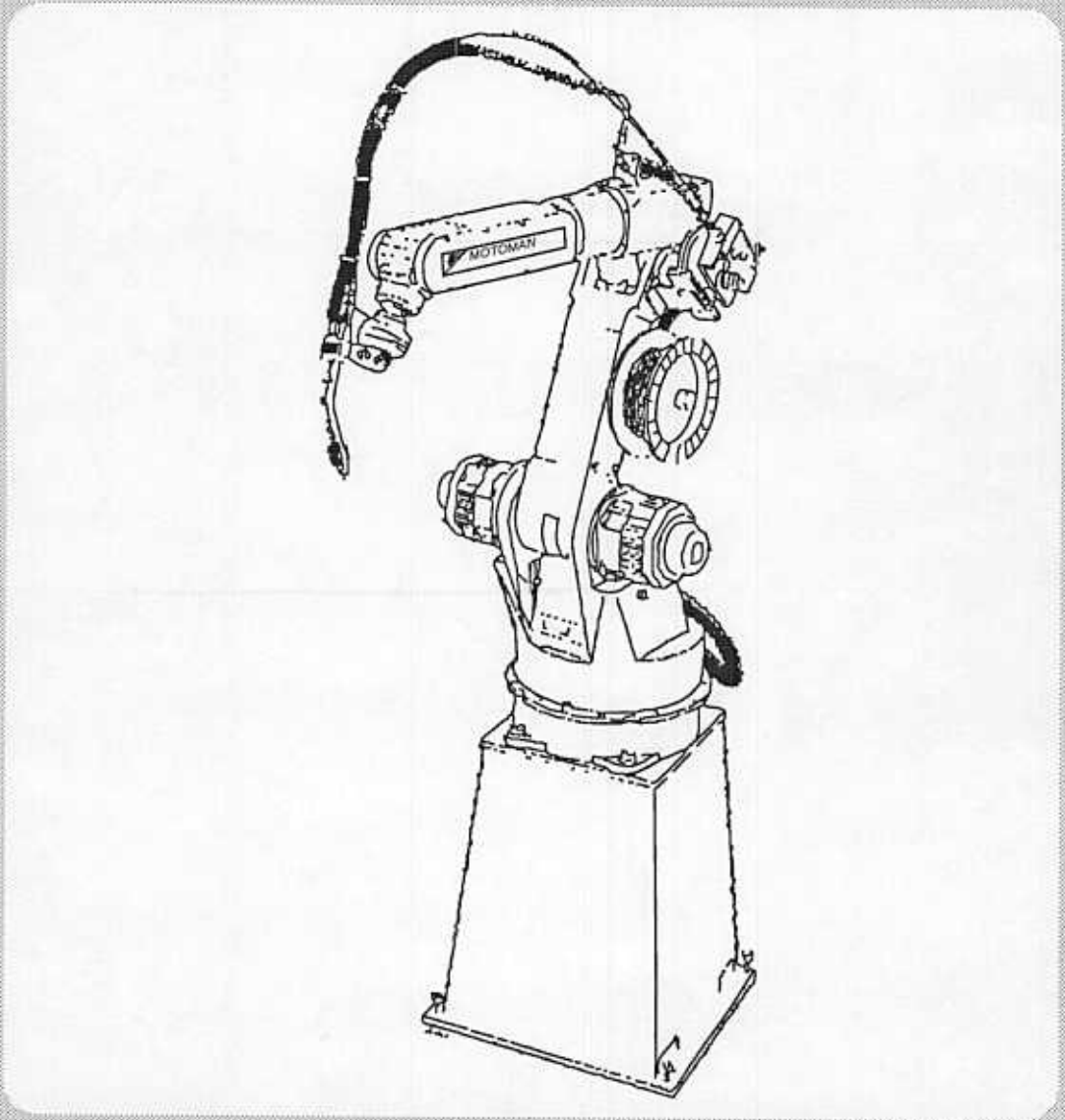
MOTOMAN

K6S - K10S

INSTRUCTION MANUAL

TOE-C945-111



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Yaskawa's fully electric industrial robot system consists of an industrial robot (Motoman-K6S/K10S), a numerical control unit (YASNAC ERC), an operating station, a workpiece mounting fixture and another equipment.

This manual is intended to give operating instructions and maintenance procedures primarily for the Motoman-K6S/K10S robot. For the numerical control unit, refer to the maintenance manual for YASNAC ERC. Instructions for the operating fixture and the another equipment are not described in this manual, since they are not furnished by Yaskawa Refer to each supplier of those devices for instructions. Read thoroughly this manual prior to maintenance and retain this for further reference.

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1 BASIC SPECIFICATIONS

1.1 BASIC SPECIFICATIONS

Table 1.1 Basic Specifications of K6S and K10S

Item \ Model		Motoman-K6S	Motoman-K10S
Operating Mode		Vertically articulated	Vertically articulated
Degree of Freedom		6	6
Payload		6 kg	
Repeatitive Positioning Accuracy		±0.1 mm	
Motion Range	S axis (turning)	340°	340°
	L axis (lower arm)	240°	240°
	U axis (upper arm)	270°	275°
	R axis (wrist roll)	360°	360°
	B axis (wrist pitch/yaw)	270°	270°
	T axis (wrist twist)	400°	400°
Maximum Speed	S axis	110°/s	120°/s
	L axis	90°/s	
	U axis	110°/s	
	R axis	240°/s	
	B axis	240°/s	
	T axis	400°/s	
Allowable Moment	R axis	1.2 kg·m	
	B axis	1.0 kg·m	
	T axis	0.6 kg·m	
Allowable Inertia GD^2	R axis	0.91 kg·m^2	
	B axis	0.67 kg·m^2	
	T axis	0.24 kg·m^2	
Weight		180 kg	
		Munsell 7.5R3/12	
Ambient Conditions	Temperature	0 to 45°C	
	Humidity	20 to 80%RH (non-condensing)	
	Vibration	Less than 0.5G	
	Others	• Free from corrosive gases or liquids, or explosive gases • Clean and dry • Free from excessive electrical noise (plasma)	
Power Capacity		5 kVA	8 kVA

1.2 PARTS NAME AND WORKING AXES

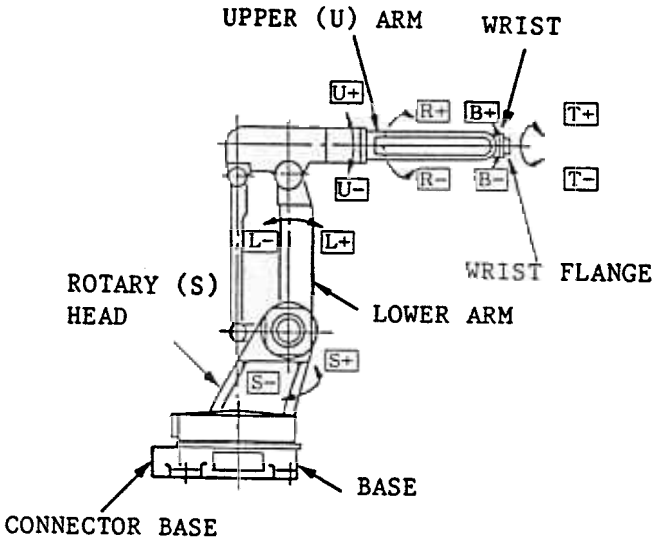
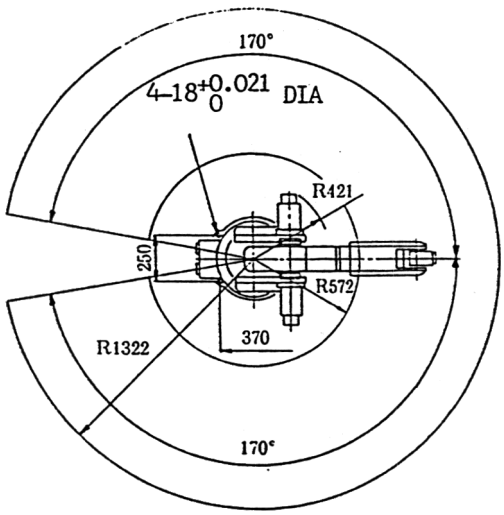


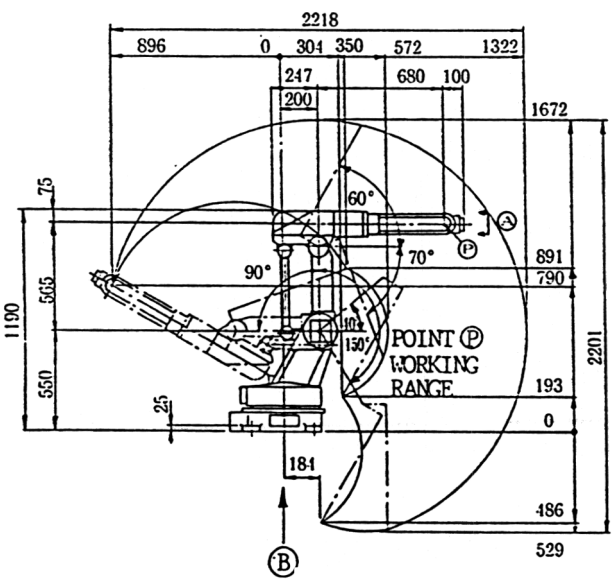
Fig. 1.1 Parts Name and Working Axes

1.3 Motoman-K6S/K10S DIMENSIONS AND WORKING RANGE

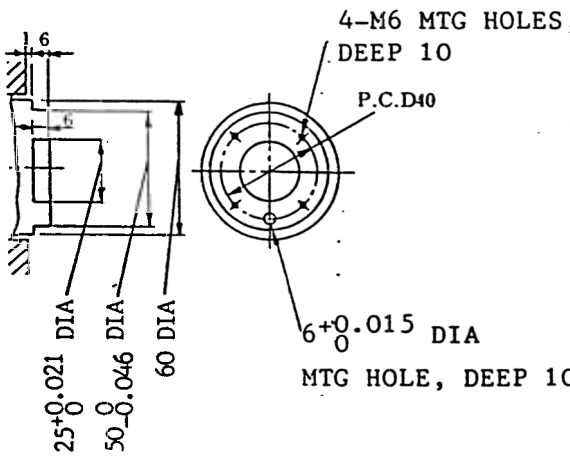
Motoman-K6S

Dimensions in mm





VIEW Ⓐ : Wrist Flange



VIEW Ⓑ : Baseplate

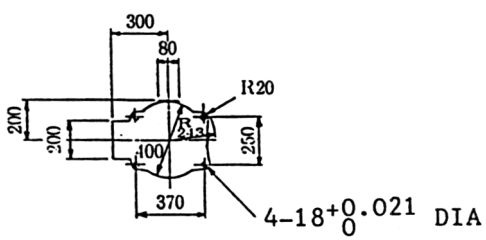


Fig. 1.2 Motoman-K6S Dimensions and Working Range

1.4 WORKING RANGE OF B-AXIS

B-axis moves in the range maintaining a constant angle to the center of U-axis, as shown in Fig. 1.4.

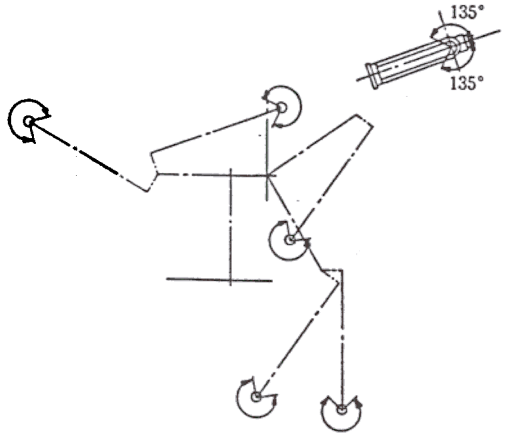


Fig. 1.4 Working Range of B-axis

1.5 ALTERABLE WORKING RANGE

The working range of S-axis can be altered according to the operating conditions as shown in Table 1.2. If alteration is necessary, contact your Yaskawa representative in advance.

Table 1.2

Item	Specifications
S-axis Working Range	±170° (Standard)
	±150°
	±120°
	±90°
	±60°
	±30°

2. ALLOWABLE LOAD FOR WRIST AND PRECAUTIONS

2.1 ALLOWABLE LOAD FOR WRIST

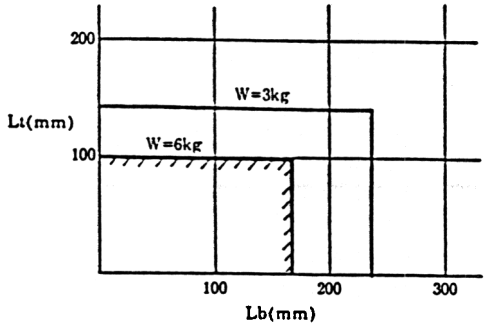
(1) The allowable load for wrist of Motoman-K6S and -K10S is 6 kg and 10 kg, respectively, including the weight of the grip. The following conditions should be observed.

Table 2.1 Moment and Total Inertia

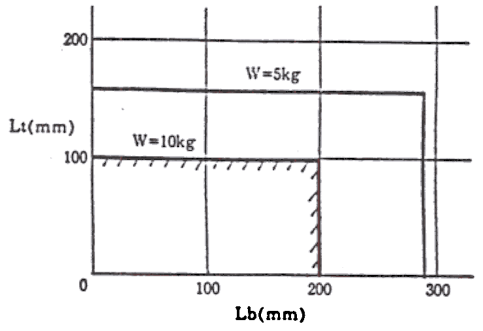
Motoman-	Axis	Moment kg·m	Total Inertia (GD^2) kg·m^2
K6S	R	1.2	0.91
	B	1.0	0.67
	T	0.6	0.24
K10S	R	2.6	2.8
	B	2.0	1.7
	T	1.0	0.5

(2) If force is applied to the wrist instead of the load, force on R-, B- and T-axis should be within the values shown in Table 2.1. Contact your Yaskawa representative for further information or assistance.

(3) Where the volume of load is small, refer to limit load gravity shown in Fig. 2.1.



(a) Motoman-K6S



(b) Motoman-K10S

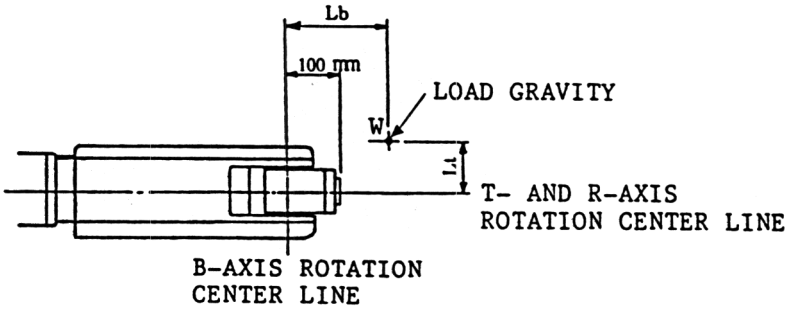


Fig. 2.1 Limit Load Gravity

2.2 ATTACHMENT MOUNTING PRECAUTIONS

1. Wash out anticorrosive paint (black) on wrist flange surface with thinner or light oil before mounting the attachment.

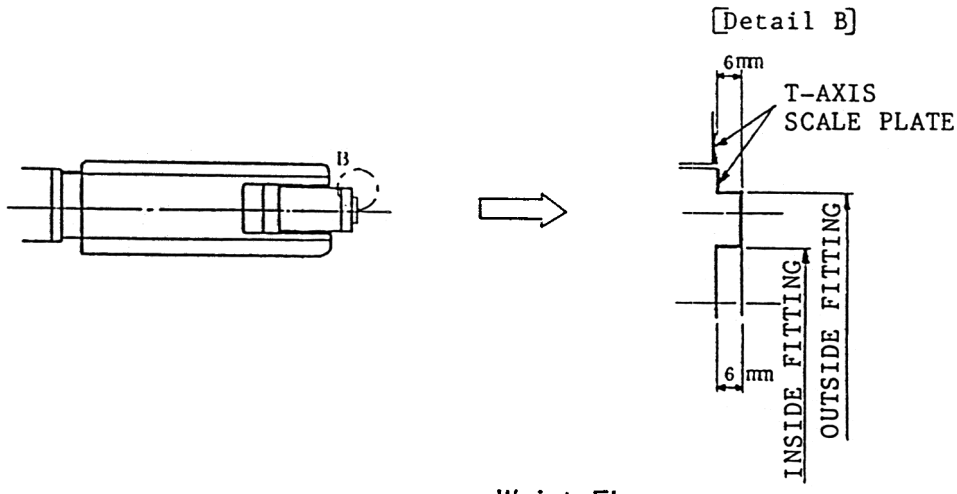
2. T-axis scale plates are mounted on wrist flange. In order to see the T-axis scale plate, we recommended that the attachment be mounted by using inside fitting.

   · Inside fitting:

   The fitting depth must be 5 mm or less.

   · Outside fitting:

   If the outside fitting is used, the fitting depth must be 5 mm or less.



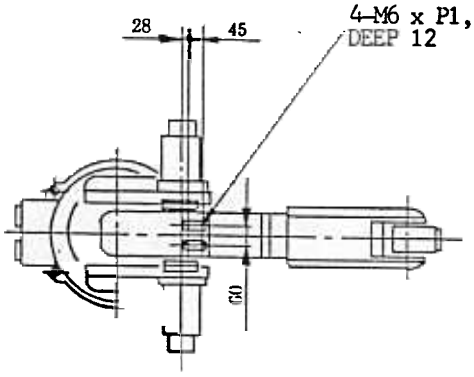
Wrist Flange

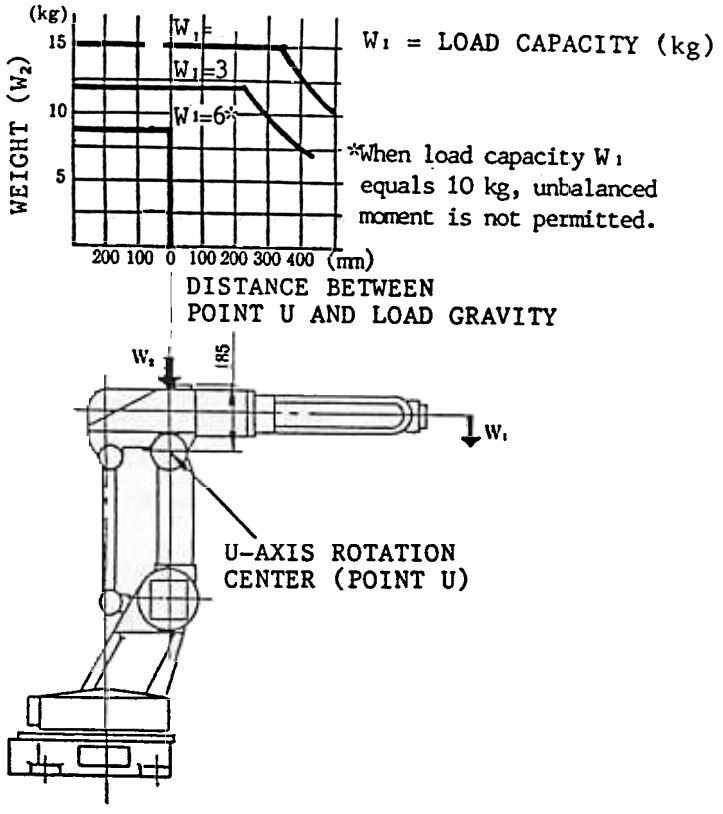
3. ALLOWABLE LOAD ON U-AXIS

When peripheral equipment is attached to the U-axis, the following conditions should be observed.

(1) Motoman-K6S

- Allowable load on U-axis: 15 kg max
- Unbalance moment at the center of U-axis rotation: 3 kg:m (at W_1=3 kg)
- Never perform additional modifications on the robot to make provisions for other conditions. For attaching the equipment on U-axis use clamps shown in Fig. 3.1.





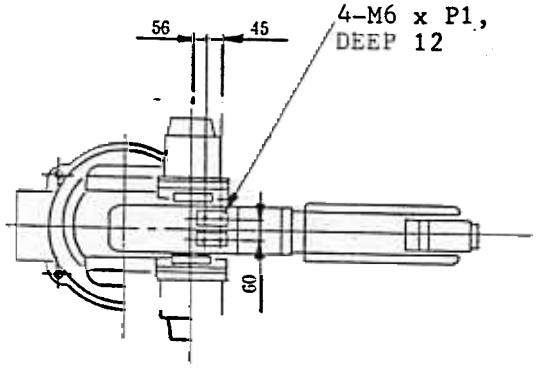
Dimensions in mm

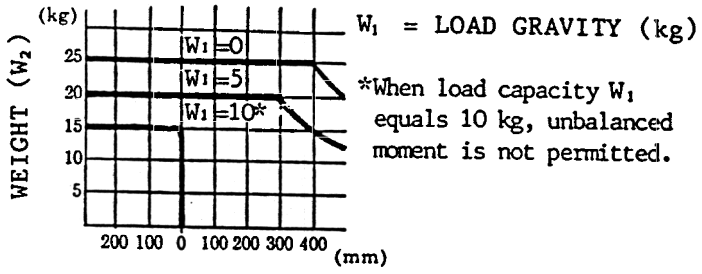
Fig. 3.1 Allowable Load on U-axis for Motoman-K6S

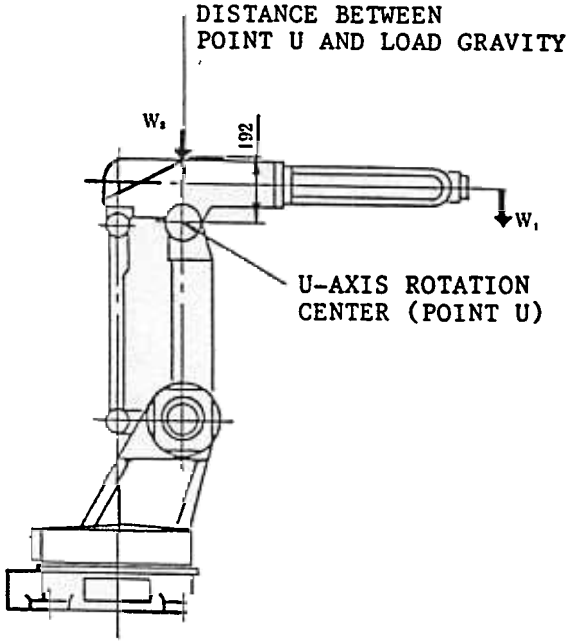
3. ALLOWABLE LOAD ON U-AXIS (Cont'd)

(2) Motoman-K10S

- Allowable load on U-axis: 25 kg max.
- Unbalance moment at the center of U-axis rotation: 6 kg:m (at W_1=5 kg)
- Never perform additional modifications on the robot to make provisions for other conditions. For attaching the equipment on U-axis, use clamps shown in Fig. 3.2.







Dimensions in mm

Fig. 3.2 Allowable Load on U-axis for Motoman-K10S

4. HANDLING

The Motoman should be lifted using wire rope thread through attached eyebolts. See Fig. 4.1. The weight of the Motoman-K6S and -K10S is approximately 180 kg and 300 kg, respectively.

CAUTION

Avoid exerting force on the arm unit, motor unit or ball screw. Never lift it too high or roughly using a crane, for it may cause injury to personnel.

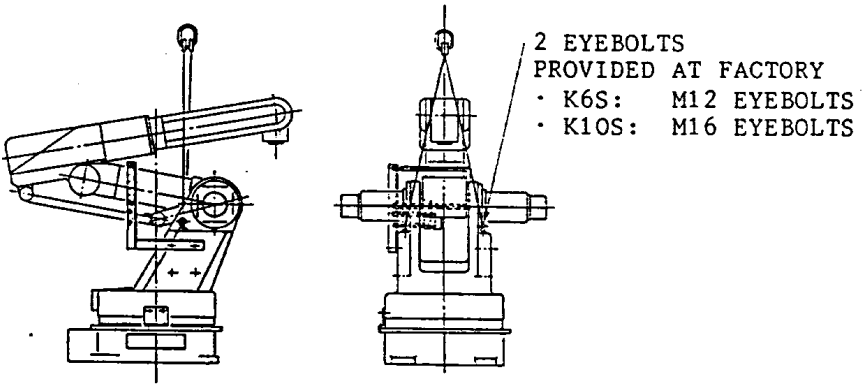


Fig. 4.1 Lifting the Motoman

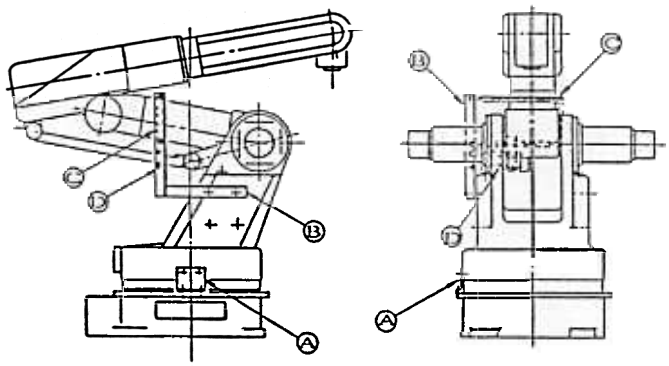
5. SHIPPING BOLTS AND JIGS

Motoman is provided with shipping bolts and jigs at Ⓐ to Ⓓ in Fig. 5.1 to protect the robot from the movement and forces during shipment. The jigs are painted yellow. Be sure to remove them before installation.

NOTE

Before turning on the power, check to be sure that the shipping bolts and jigs have been removed. Failure to do so may cause damage to the driving parts.

These shipping bolts and jigs must be stored for future use in the event of moving or carrying the robot.



	Number of Hexagon Socket Head Cap Bolts	Number of Nuts
Ⓐ	M6×4	-
Ⓑ	M10×2	-
Ⓒ Ⓓ	-	M10×4

Fig. 5.1 Positions of Shipping Bolts and Jigs

6. INSTALLATION

The Motoman should be firmly mounted on a baseplate, or foundation rigid enough to support the Motoman and withstand repulsion forces during acceleration and deceleration. Mount the baseplate in either of the following ways. For mounting dimensions of Motoman baseplate, see par. 1.3.

(1) Where the Motoman and the mounting fixture are installed on a common flat steel plate (common base):

The common base should be rugged and durable to prevent shifting of the Motoman or the mounting fixture. When the Motoman is used for welding, connect the ground lead to the Motoman baseplate.

For Motoman baseplate mounting, see Fig. 6.1

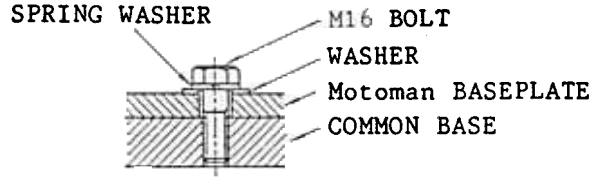


Fig. 6.1 Motoman Baseplate Mounting

(2) Where the Motoman is mounted directly on the floor:

The floor should be rigid enough to support the Motoman. Foundation construction procedure are as follows.

- Where the concrete thickness (floor) is 150 mm or more

  (i) The surface of floor should be level and even. If it is uneven, grind the swell and flatten the surface.

  (ii) Check for cracks on the floor. If any crack is found, remove the material around the crack and rebuild the floor with concrete. Place the robot by fastening the plate with M20 anchor bolts. The plate is tapped for M20 bolts.

- Where the concrete thickness (floor) is less than 150 mm or an earth foundation.

  (i) Dig a footing in the floor area.

  (ii) Spread stones in the excavated area and tamp them sufficiently to make a solid stone bed.

  (iii) Fill the empty space of the stone bed with grout, and lay the concrete foundation. It should be more than 150 mm thick, and the surface must be level and even.

  (iv) The concrete should be cured for more than a week before installing the robot.

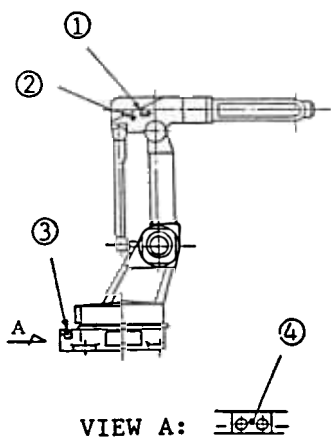
(3) Mounted types

Foot-mounted (Standard), wall-mounted and ceiling-mounted types are available.

1. For wall-mounted type, S-axis working range is as follow.
   - Motoman-K6S: ±30°
   - Motoman-K10S: ±45°
2. The brakes in S-axis and in Wrist (R-, B- and T-axis) are optional. When using wall-mounted type, S-axis should be provided with a brake.

(4) Incorporated cables and air duct for application

1. Six cables and an air duct are incorporated in Motoman for user application.
   - Allowable current of cables: 6.6 A or below
   - Max pressure of air duct: 9.9 kgf/cm^2 or below



① Incorporated cable connector Type MS3102A 18-1S (with cap): Connect the plug type MS3106B 18-1P to this.

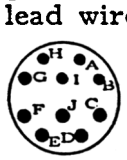
② Air inlet: PT3/8 tap, with bull plug

③ Incorporated cable connector Type MS3102A 18-1P (with cap): Connect the plug type MS3106B 18-1S to this.

④ Air inlet: PT3/8 tap, with bull plug

Fig. 6.2 Locations of Incorporated Cable Connectors and Air Inlet

2. The same pin Nos. (A to F) between connectors are connected with 0.75 mm^2 lead wires.



- Incorporated cables: 0.75 mm^2, 6 cables
- Using pins: A to F

Fig. 6.3 Detailed Drawing of Connector Pin No.

7. Motoman CONSTRUCTION

7.1 POSITIONS OF LIMIT SWITCHES FOR AXES

For the functions of the limit switches, see Table 7.1. The limit switches (LS) are located as shown in Fig. 7.1. The inspection operation and adjustments of the limit switches should be made after removing their covers (if inspection covers are provided).

Table 7.1 Limit Switch Functions

LS No.	Axis	Function
1LS	S	Overrun Limit Switch
2LS	L	
3LS		

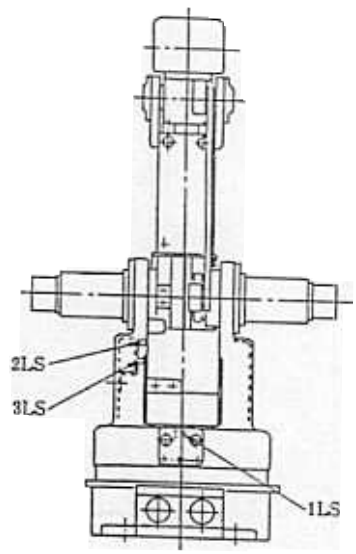


Fig. 7.1 Locations of S- and L-axis Limit Switches

7.2 INTERNAL CONNECTIONS

Highly reliable connectors which can be easily removed are used with each connector part. In Figs. 7.3 and 7.4, "—≪—" shows pin connector which can also be removed. For the numbers and locations of connectors, see Fig. 7.2.

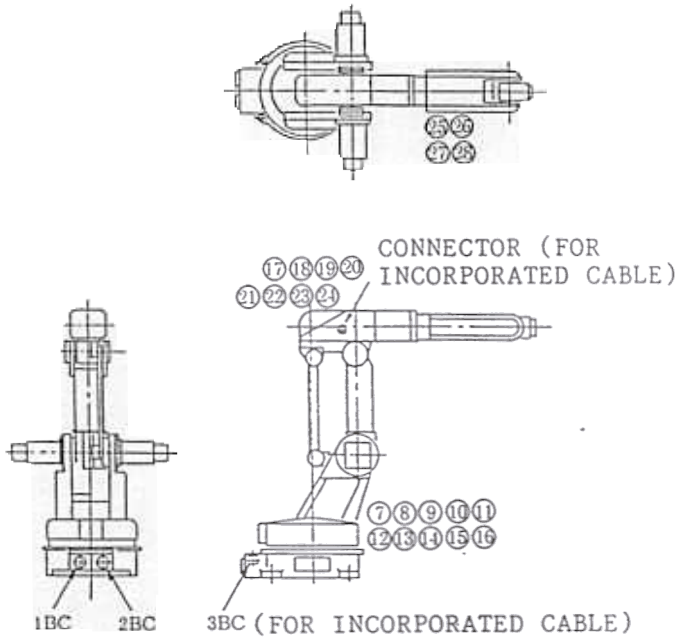
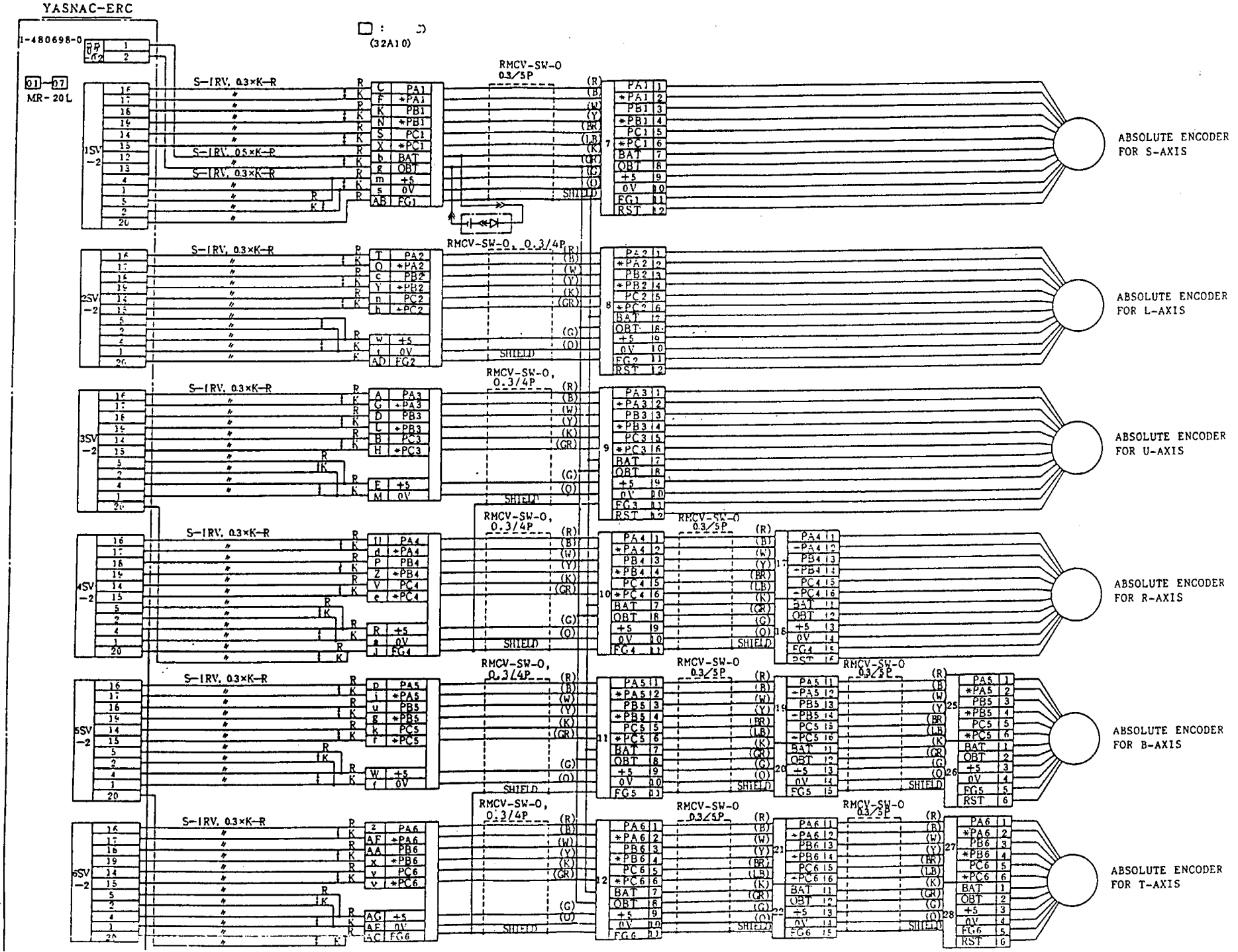


Fig. 7.2 Locations and Numbers of Connectors

Table 7.2 List of Connector Type

Name	No.	Receptacle Type	Plug Type
Base Connector	1BC	CA3102A.32A10P	CA3106B.32A10S
	2BC	MS3102A.36A10P	MS3106B.36A10S
For Incorporated Cable	3BC	MS3102A.18-1P	MS3106B.18-1S (Optional)
Intermediate Connector	⑦ ⑧ ⑨ ⑩ ⑪ ⑫	172170-1	172162-1
	⑬ ⑭ ⑮ ⑯ ㉓ ㉔	1-480276-0	1-171196-0
	⑲ ⑳ ㉑ ㉒	172168-1	172160-1
Feedback Unit Connector	⑰ ⑱ ㉕ ㉖ ㉗ ㉘	172168-1	172160-1
Connector for Incorporated Cable	—	MS3106B.18-P	MS3102A.18-1S (Optional)


YASNAC-ERC
1-480698-0
(32A10)
MR-20L
S-IRV, 0.3×K-R
S-IRV, 0.5×K-P
RMCV-SW-O 0.3/5P
RMCV-SW-O, 0.3/4P
RMCV-SW-O 0.3/5P
ABSOLUTE ENCODER FOR S-AXIS
ABSOLUTE ENCODER FOR L-AXIS
ABSOLUTE ENCODER FOR U-AXIS
ABSOLUTE ENCODER FOR R-AXIS
ABSOLUTE ENCODER FOR B-AXIS
ABSOLUTE ENCODER FOR T-AXIS
SHIELD
— 18A —
P, T-axis cont'd

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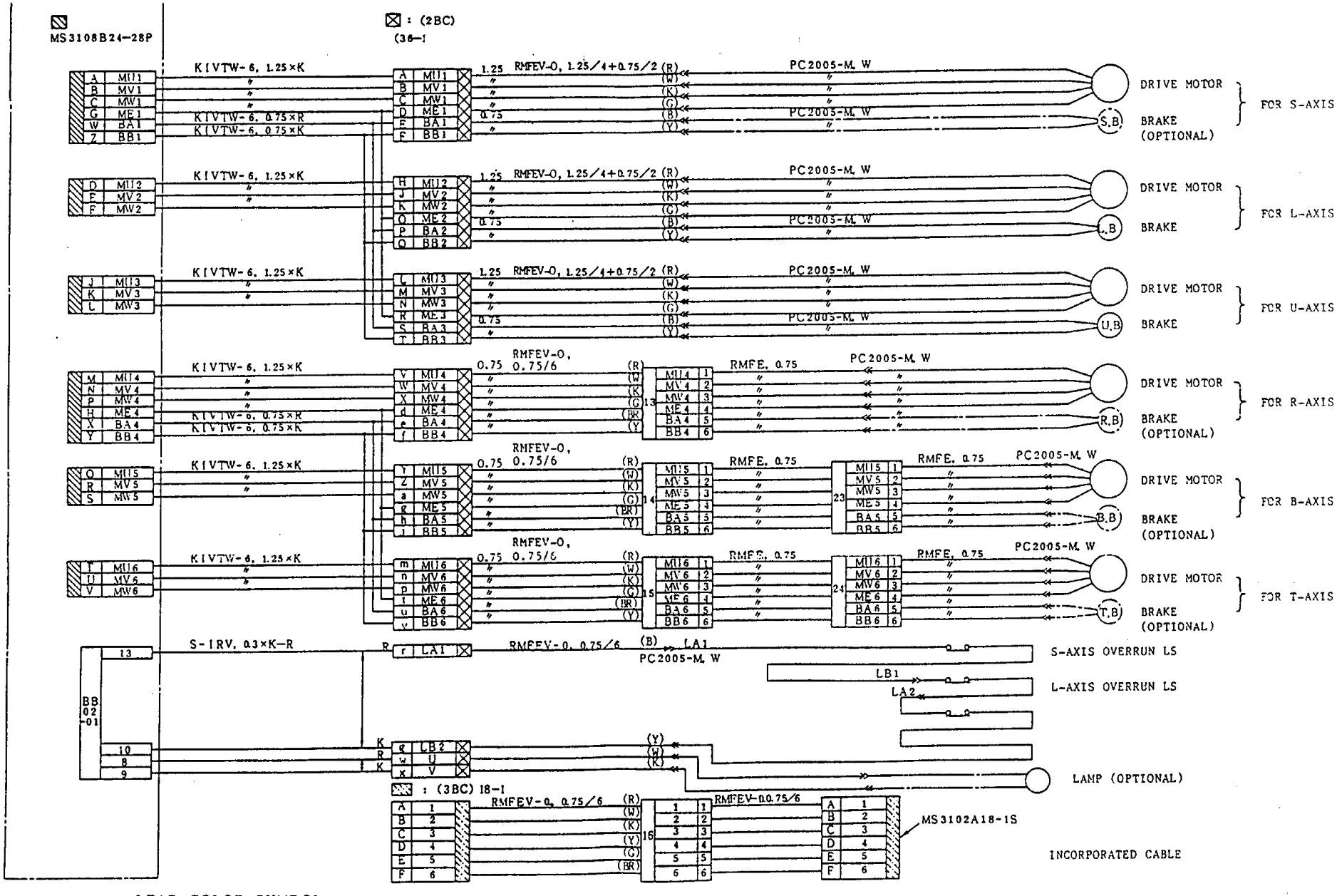

LEAD COLOR SYMBOL

(B):	BLUE	(K):	BLACK	(R):	RED
(BR):	BROWN	(LB):	LIGHT BLUE	(W):	WHITE
(G):	GREEN	(O):	ORANGE	(Y):	YELLOW
(GR):	GRAY				

Fig. 7.3 Internal Connection Diagram for Motoman-K6S

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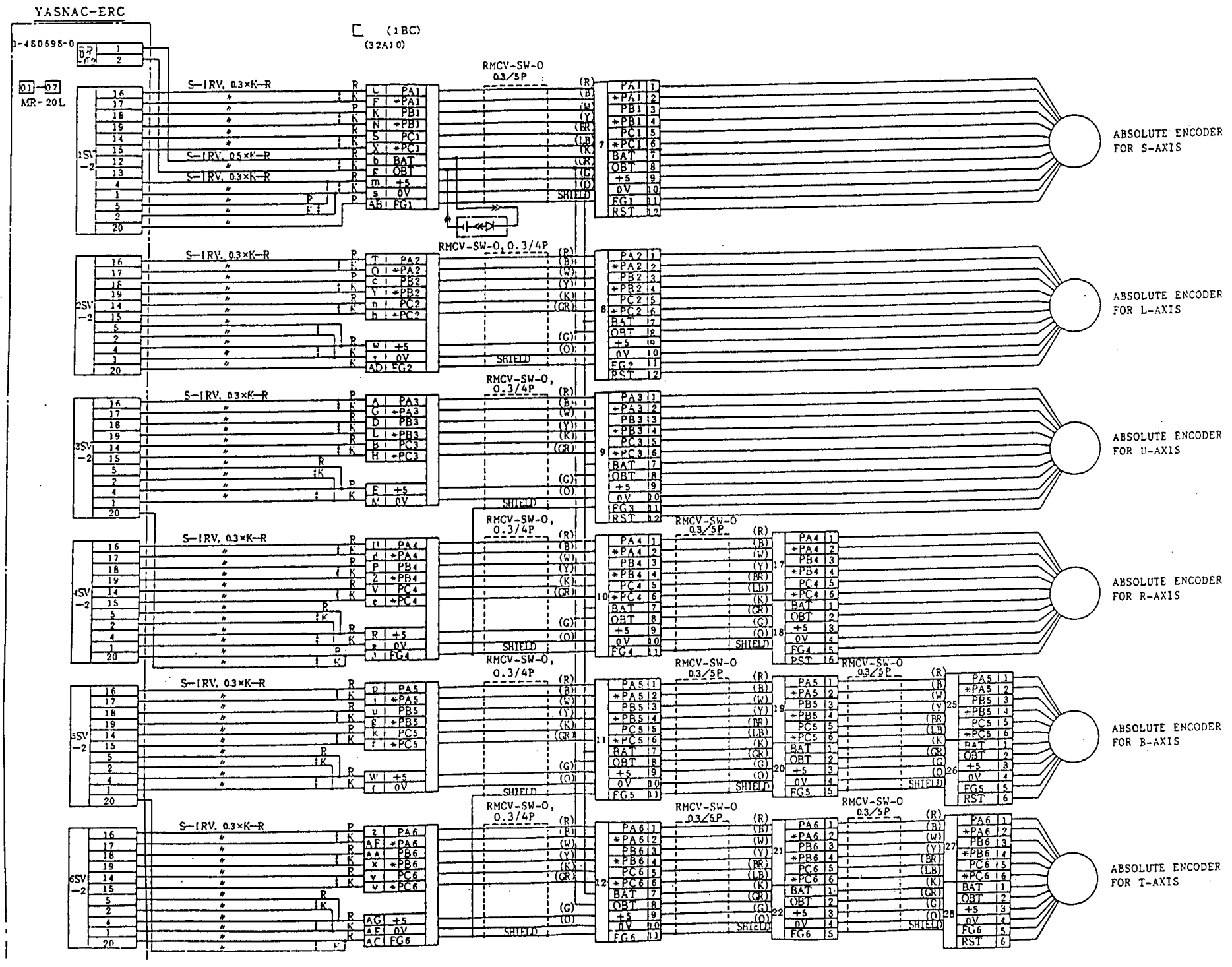
YASNAC-ERC
(1BC)
(32A10)
1-460698-0
01~07
MR-20L
S-IRV, 0.3×K-R
S-IRV, 0.5×K-R
RMCV-SW-O 0.3/5P
RMCV-SW-O, 0.3/4P
RMCV-SW-O 0.3/5P
1SV -2
2SV -2
3SV -2
4SV -2
5SV -2
6SV -2
SHIELD
ABSOLUTE ENCODER FOR S-AXIS
ABSOLUTE ENCODER FOR L-AXIS
ABSOLUTE ENCODER FOR U-AXIS
ABSOLUTE ENCODER FOR R-AXIS
ABSOLUTE ENCODER FOR B-AXIS
ABSOLUTE ENCODER FOR T-AXIS
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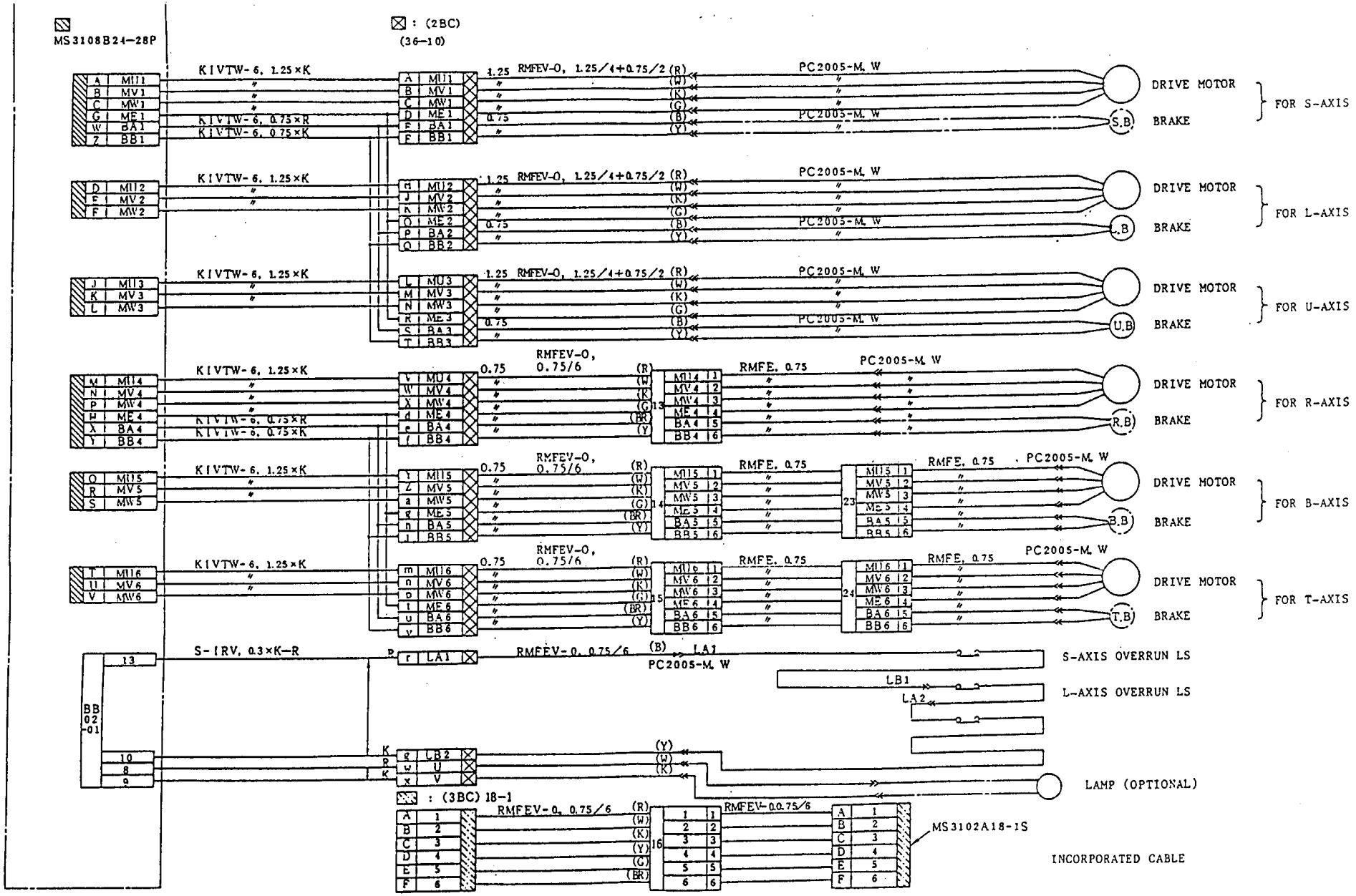

LEAD COLOR SYMBOL

(B):	BLUE	(K):	BLACK	(R):	RED
(BR):	BROWN	(LB):	LIGHT BLUE	(W):	WHITE
(G):	GREEN	(O):	ORANGE	(Y):	YELLOW
(GR):	GRAY				

Fig. 7.4 Internal Connection Diagram for Motoman-K10S

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8. MAINTENANCE AND ADJUSTMENT

8.1 INSPECTION SCHEDULE

To insure optimum life of operation, a suggested schedule of periodical inspections and adjustments is offered. Adjust the schedule according to your operating conditions. Especially, axes frequently used for handling should be checked at half-periods of the following schedule.

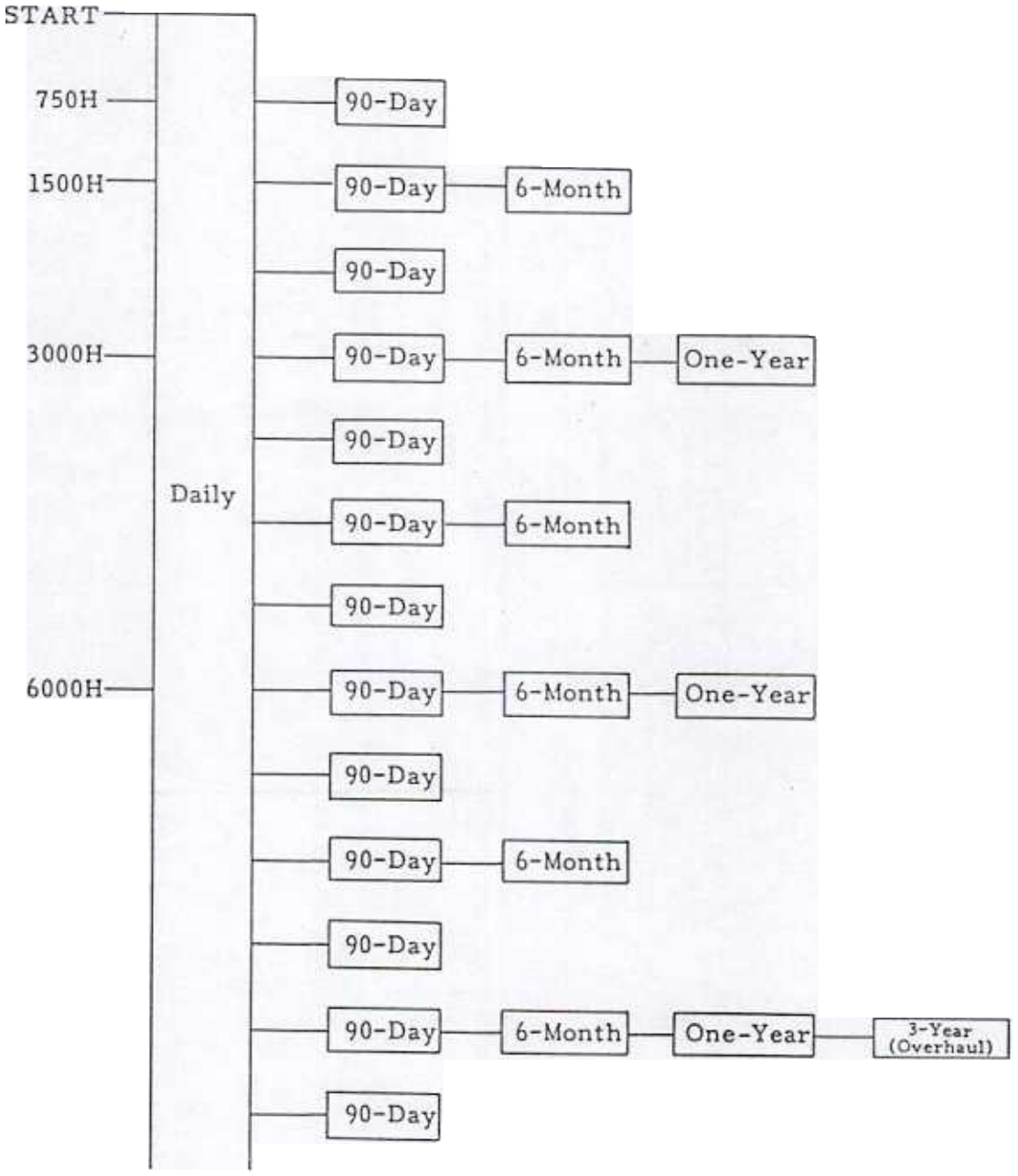


Fig. 8.1 Inspection Schedule

8.2 INSPECTION ITEMS

Table 8.1 Inspection Items

No.*	Schedule: Daily	Schedule: 90-Day (750H)	Schedule: Six-Month (1500H)	Schedule: Annual (3000H)	Schedule: Three-Year† (9000H)	Item	Method	Operation
①	○					Scale plate	Visual	Check for matching or stain of the mark.
②	○					External lead	Visual	Check for damage and deterioration of leads.
③	○					Working area and Motoman	Visual	Clean the working area if dust or spatter exists. Check for damage and outside cracks.
④		○				Baseplate mounting bolt	Wrench	Tighten if the bolt is loose. Replace if damage.
⑤			○			Base connector	Visual, Manual	Check manually for looseness of connector. Tighten.
⑥				○		Lead in Motoman (S-axis)	Multimeter	Check condition between the main connector of base and intermediate connector on S-head by shaking wire with hand.
⑦				○		Limit switch, dog	Screw-driver, Wrench, Multimeter	Check for stain, damage and looseness of the dog. Tighten and check the dog movement.
⑧				○		Link	Visual, Manual	Move the L- and U-axis forward, backward, up and down to check for looseness of the bearing.
⑨					○	Leads in Motoman (S-, L-, U-, R-, B-, T-axis)	——	Replace the leads. Apply grease (Multemp -PS2A).
⑩					○	Battery unit in Motoman	Multimeter	If the voltage is 2.8 V or less with check, replace the battery unit.
⑪				○	○	S-axis speed reducer	Grease gun	Check for damage of speed reducer. Apply grease (Epinoc APO). See Par. 8.2.2.
⑫				○	○	L- and U-axis speed reducer		
⑬				○	○	Wrist-axis speed reducer	Grease gun	Check for damage of speed reducer. Apply grease (Harmonic grease SK1).

* Inspection No. corresponds to the number in Fig. 8.2.

† The Motoman must be overhauled at the three-year inspection. Inspection Nos. ⑨ to ⑬ are required replacement items.

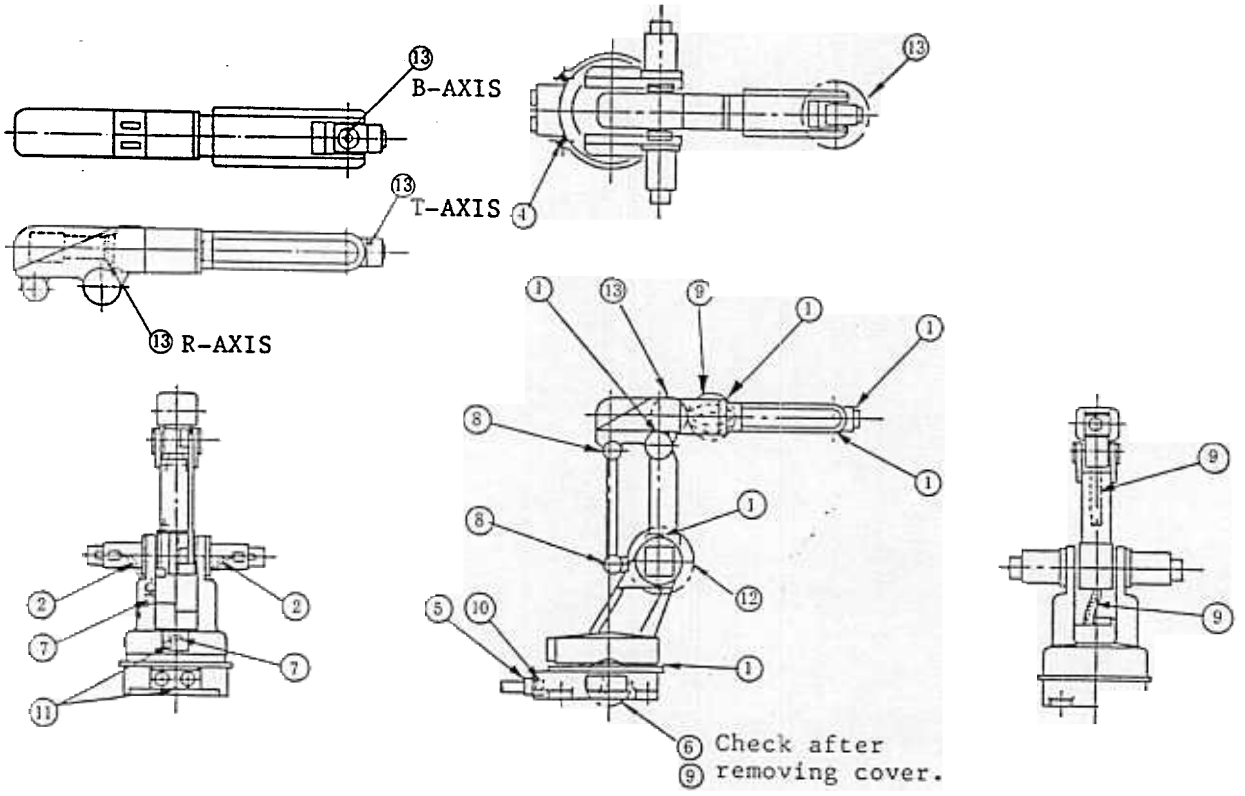


Fig. 8.2 Inspection Parts and Inspection Number

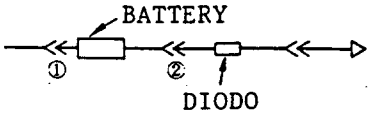
8.2.1 Replacement Procedures for Battery Unit

If the battery charge becomes too low or is depleted, replace it according to the following procedures.

(1) Remove the side cover (U-axis motor side) of rotary head.

(2) Remove the battery unit mounting screw (M5).

(3) Remove the pins ①, ② (PC-2005-M, W) on both sides of battery.



(4) Remove the old battery and mount the new battery.

NOTE

1. When the battery unit is replaced.
   Keep the power ON between YASNAC and Motoman.

2. Be sure to insert the pins in correct direction.

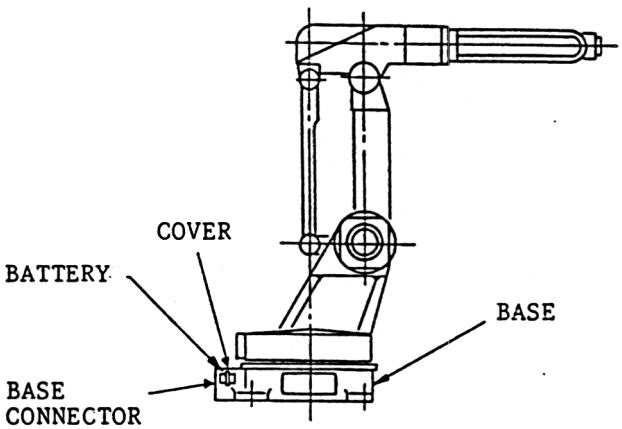


Fig. 8.3 Battery Location

8.2.2 Grease Replacement Procedures for S-, L- and U-axis Reduction Motor

(1) Remove plugs Ⓑ, Ⓓ and Ⓕ.

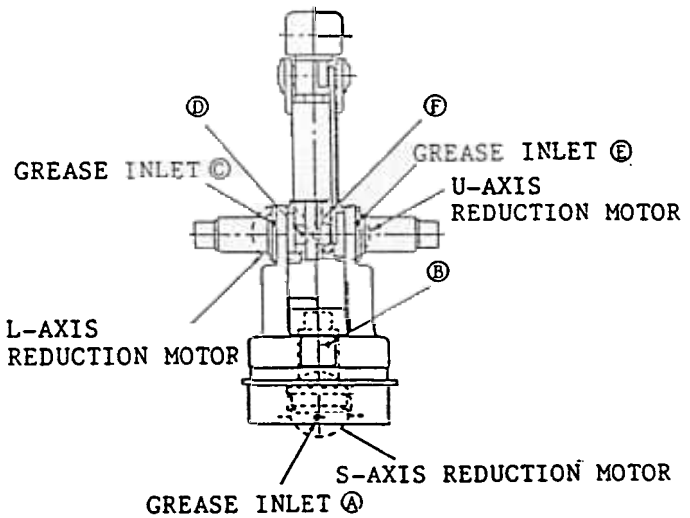
(2) Inject grease (EPINOC APO) into grease inlet on Ⓐ, Ⓒ and Ⓔ using grease gun.

Table 8.2 Amount of Greasing

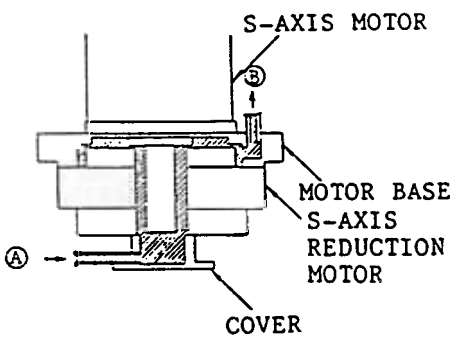
	S-axis	L- and U-axis
Motoman-K6S	700 cc	300 cc
Motoman-K10S	600 cc	400 cc

(3) The grease replacement is completed when new grease appears from Ⓑ Ⓓ and Ⓕ. The new grease is distinguished from old grease by color.

(4) Wipe parts Ⓑ, Ⓓ and Ⓕ with a cloth and reinstall the plug.



[Detailed S-axis Reduction Motor Part]



[Detailed L- and U-axis Reduction Motor Part]

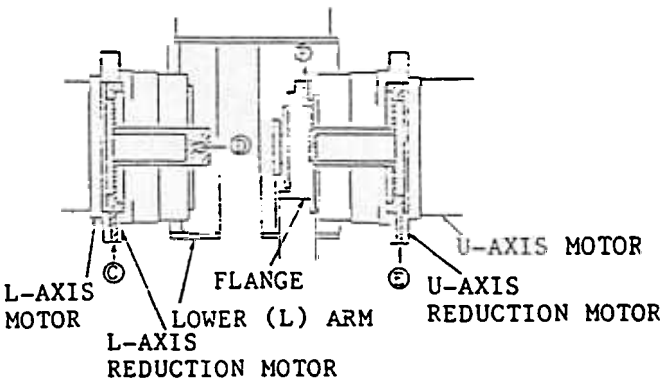


Fig. 8.4 Grease Lubricated Parts

8.2.3 Note for Wrist Unit Maintenance

The motor and feedback unit are provided with the wrist unit. To counteract fumes from welding operation, etc., the hatched parts are sealed with sealing compound so that fumes from welding operation, etc. do not penetrate into the wrist unit. Therefore, if the wrist shaft is disassembled, reseal with sealing compound (KE45RTV).

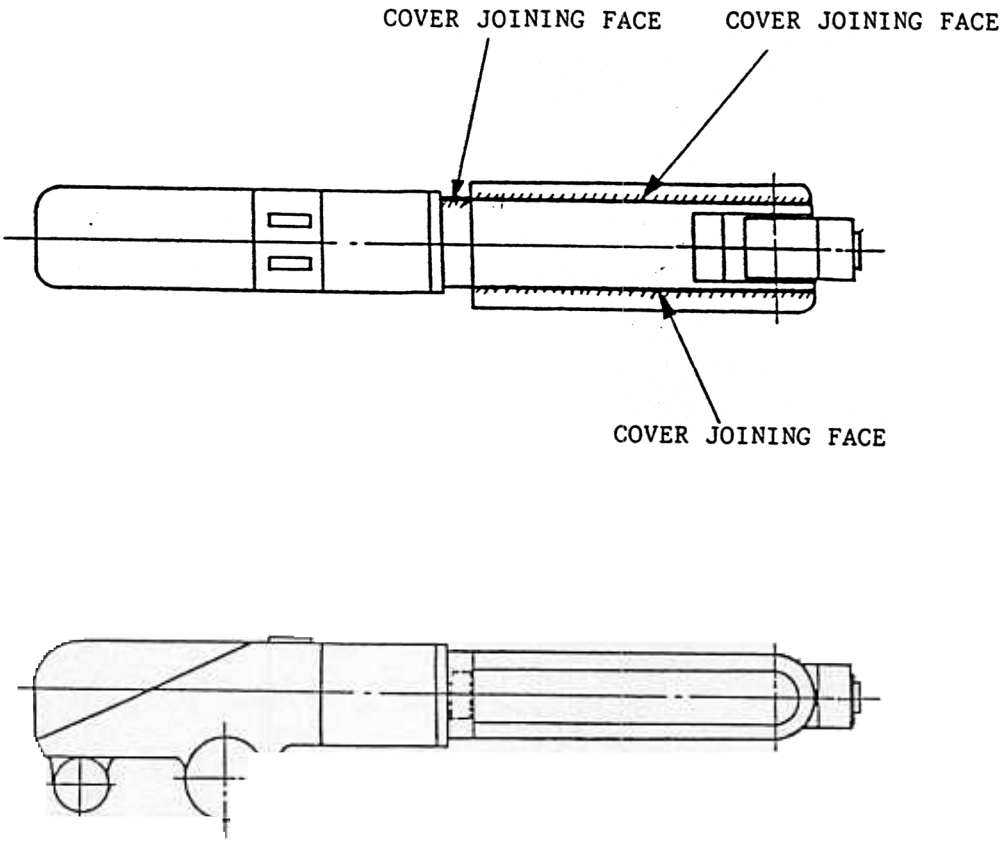


Fig. 8.5 Sealing Part of Wrist Unit

9. RECOMMENDED SPARE PARTS

It is recommended that the following parts and components be kept in stock as spare parts for the Motoman-K6S/K10S. List of spare parts for Motoman-K6S and K10S is shown in Table 9.1 and 9.2, respectively. They are ranked A, B and C, as follows.

Rank A: Expendable parts and those for which frequent replacement can be expected.

Rank B: Parts for which replacement may be necessary as a result of frequent operation.

Rank C: Drive units

Table 9.1 Spare Parts for Motoman-K6S

Rank	Spare Part No.	Parts Name		Type	Manufacturer	Qty	Qty per Unit	Remarks	
A	1	Limit switch set		HW8471013-A	Omron Tateishi Electronics Co.	1	1	S-axis, Lead terminal treatment completion	
	2			HW8471014-A				L-axis, Lead terminal treatment completion	
	3			HW8471015-A					
	4	Grease		Harmonic grease SK-1	Harmonic drive System Co., Ltd.	2.5 kg	–		
	5			Epinoc APO	Nippon Oil				
	6			Multemp PS2A	Kyodo Oil Co., Ltd.				
	7	Silicon rubber compound (tube)		KE45RTV	Shin-Etsu Chemical Co., Ltd.	1			
B	8	Gear		HW8425135-1 HW8425133-1	Yaskawa Electric Mfg. Co., Ltd.	1	1	T-axis (Tip)	
	9			HW8425135-1 HW8425134-1		1	2		
	10	Speed reducer	S-axis	HW8380795-A		1	1		
	11		L-, U-axis	HW8380833-A		1	1		
	12		R-axis	HW8380798-A		1	1		
	13		B-axis	HW8380800-A		1	1		
	14		T-axis	HW8380799-A		1	1		
C	15	AC Servo-motor	S-axis	HW8381210-A	Yaskawa Electric Mfg. Co., Ltd.	1	1	Without brake	With key, Lead terminal treatment completion
	16		L-, U-axis	HW8381211-A		1	2	With brake	
	17		R-, B-, T-axis	HW8381209-A		1	3	Without brake	
	18	Internal wiring	S-axis	HW8271010-A		1	1		
	19		R-, B-, T-axis	HW8271011-A		1	1	in L arm	
	20		B-axis	HW8371217-A		1	1		
	21		T-axis	HW8371218-A		1	1		
	22	Wrist unit		HW8171509-A		1	1		

Table 9.2 Spare Parts for Motoman-K10S

Rank	Spare Part No.	Parts Name		Type	Manufacturer	Qty	Qty per Unit	Remarks	
A	1	Limit switch set		HW8471013-A	Omron Tateishi Electronics Co.	1	1	Lead terminal treatment completion	S-axis
	2			HW8471014-A					
	3			HW8471024-A					
	4	Grease		Harmonic grease SK-1	Harmonic drive System Co., Ltd.	2.5 kg	—		
	5			Epinoc APO	Nippon Oil				
	6			Multemp PS2A	Kyodo Oil Co., Ltd.				
	7	Silicon rubber compound (tube)		KE45RTV	Shin-Etsu Chemical Co., Ltd.	1	—		
B	8	Gear		HW8425135-1 HW8425133-1	Yaskawa Electric Mfg. Co., Ltd.	1	1		
	9			HW8425135-1 HW8425134-1		1	2		
	10	Speed reducer	S-axis	HW8380796-A		1	1		
	11		L-, U-axis	HW8380832-A		1	2		
	12		R-axis	HW8380797-A		1	1		
	13		B-axis	HW8380800-A		1	1		
	14		T-axis	HW8380799-A		1	1		
C	15	AC Servo-motor	S-, L-, U-axis	HW8381254-A	Yaskawa Electric Mfg. Co., Ltd.	1	2	With brake	With key, Lead terminal treatment completion
	16		R-, B-, T-axis	HW8381212-A		1	3	Without brake	
	17	Internal wiring	S-axis	HW8271015-A		1	1		
	18		R-, B-, T-axis	HW8271016-A		1	1	in L arm	
	19		B-axis	HW8371227-A		1	1		
	20		T-axis	HW8371226-A		1	1		
	21	Wrist unit		HW8171509-A		1	1		

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MOTOMAN K10S
INSTRUCTION MANUAL

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